# Space Weather Technical Forecast

Issued on Saturday, 28 October 2023 at 01:10 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

## Space Weather Forecast Headline: Coronal hole enhancement Days 2-3 (29-30 Oct) with G1-G2/Minor to Moderate Geomagnetic Storms expected.

## Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Has been Low. Activity started the 24 hour period at a C9 level, on the tail of the M-class flare that occurred late on the 26th. After x-ray activity had returned to background levels isolated C-class flares occurred, the largest of which was a C2 at 27/0855 UTC from close to AR3473, probably from a filament eruption.

There are currently 4 numbered regions on the visible disc, and one new unnumbered region, all of which are small and simple. One previously unnumbered region has faded, and AR3468 is now barely visible. Most regions are showing signs of gradual decay.

No Earth-directed CMEs have been observed in available imagery.

**Solar Wind / Geomagnetic Activity:** The solar wind, as measured by DSCOVR and ACE at L1, started at slightly elevated levels around 480 km/s, with a brief peak to 500 km/s at 27/0040 UTC, and then gradually declined to end the period at background levels of 360 km/s. Initially below average from 27/0900UTC the density gradually increased, reaching average levels. The Interplanetary Magnetic Field (IMF), started at moderate levels, occasionally peaking at 11nT, but decreased to weak levels after 27/1000 UTC. The north-south component, Bz, was mostly orientated southward and has fluctuated between weak and moderate levels, ranging between +4 and -9nT. Phi angle has remained positive (away from the Sun). Geomagnetic activity was Unsettled to Active (Kp 3-4) to begin the day, then declined to Quiet (Kp 1-2) levels during the second half of the day.

**Energetic Particles / Solar Radiation:** GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was largely at background levels for the first half of the day, then increased to predominantly moderate levels, peaking at 307 pfu. The associated 24-hour fluence remains well below the Active (1e8 integrated pfu) threshold, despite a gradual upward trend. The observation at 28/0000UTC was 6.94e6 integrated pfu.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Very Low or Low activity is expected, with isolated C-Class flares. There is a slight chance of isolated M-flares, mainly from AR3473 but also potentially from the arrival or return of sunspot regions to the visible disc.

**Solar Wind / Geomagnetic Activity:** There are no Earth directed CMEs expected. The next solar wind enhancement is expected to arrive either late tomorrow or more likely early Day 3 (30 Oct) from large coronal holes CH65 and CH66.

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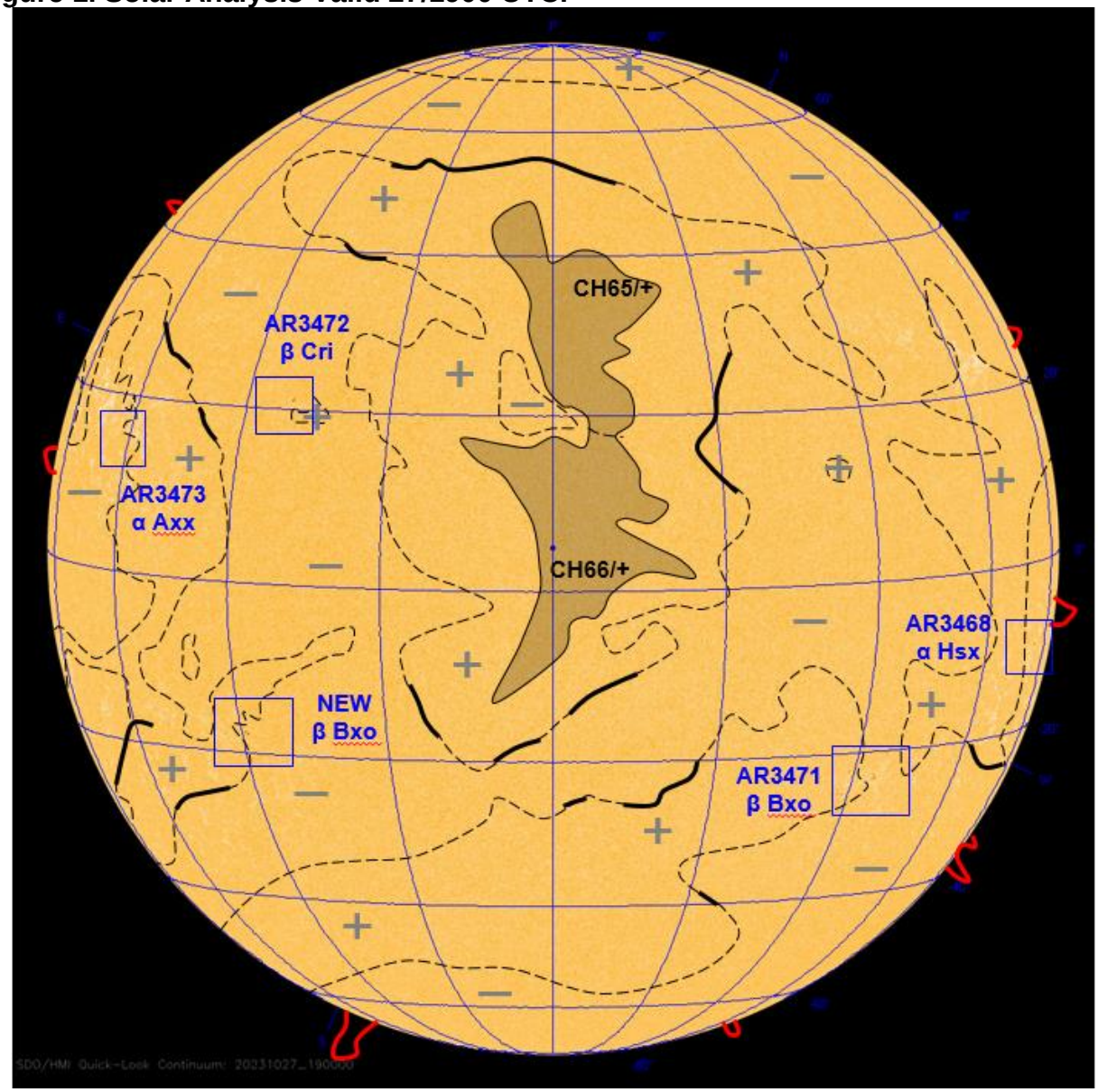
The solar wind speed is expected to become elevated, or possibly strong. Predominantly Quiet (Kp 0-2) geomagnetic activity is expected until the arrival of the high speed stream (HSS) and associated CIR. Then G1-G2/Minor to Moderate Geomagnetic Storms (Kp 5-6) are likely Days 2-3. Activity is then expected to decline during day 4 (31st) as the influence of the HSS wanes.

**Energetic Particles / Solar Radiation:** High energy (greater than 10MeV) proton flux is expected to persist at Background. High energy electron flux (greater than 2MeV) is expected to remain at predominantly moderate levels today, then decreasing to background levels tomorrow or early day 3 with the onset of the HSS and associated geomagnetic activity. Then little change until late day 4 (31st) when flux levels are likely to rapidly increase under the influence of the HSS, probably reaching High levels by the end of the period. The associated 24 hour fluence is forecast to remain below the Active threshold (1e8 integrated pfu), but with an increasing trend today and again at the end of the forecast period.

**Figure 1. Solar Analysis Valid 27/1900 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

There are currently no Earth-directed CMEs forecast.

The next solar wind enhancement is expected to arrive either late tomorrow or more likely early Day 3 (30 Oct) from large coronal holes CH65 and CH66. SWPM is not considered to provide a good steer on the potential wind enhancement, due to the non-recurrent nature of these coronal holes and influence from CMEs during the last rotation. Wind speeds are anticipated to increase to elevated, possibly strong levels 600-650 km/s.
MOSWOC ENLIL assessment of the solar wind environment is currently low confidence as the model is bringing the onset of fast winds from CH65/+ and CH66/+ later today, at least 24 hours earlier than current expectations. The early onset produced by Enlil may be the result of modelling the return of CH54/+ which previously was significantly more advanced on the disc than CH65/+.
Predominantly Quiet (Kp 0-2) geomagnetic activity is expected until the arrival of the high speed stream (HSS) and associated CIR. Then G1-G2/Minor to Moderate Geomagnetic Storms (Kp 5-6) are likely Days 2-3. Activity is then expected to decline during day 4 (31st) as the influence of the HSS wanes.
There are a number of filaments on the visible disc that have the potential to disrupt or lift-off, producing CMEs. These will be monitored during the period, although no contribution to geomagnetic activity is currently included.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 10 | 40 | 80 | 50 |
| Strong | G3 | No | 1 | 5 | 10 | 5 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Figure 2: Latest AIA/211 image showing CH65 and CH66.**

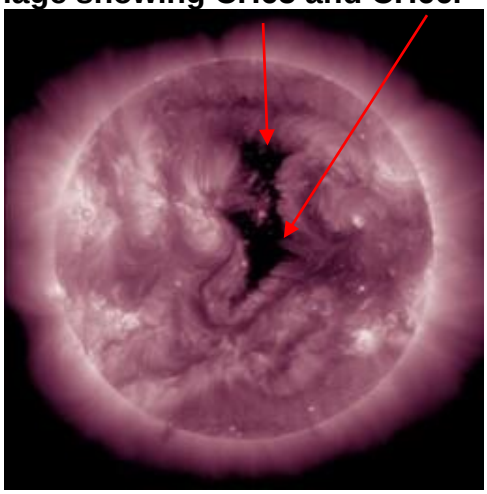

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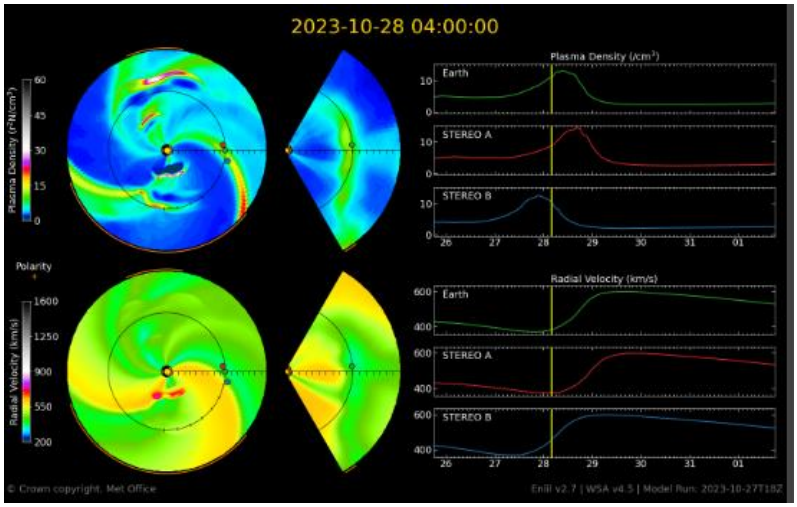
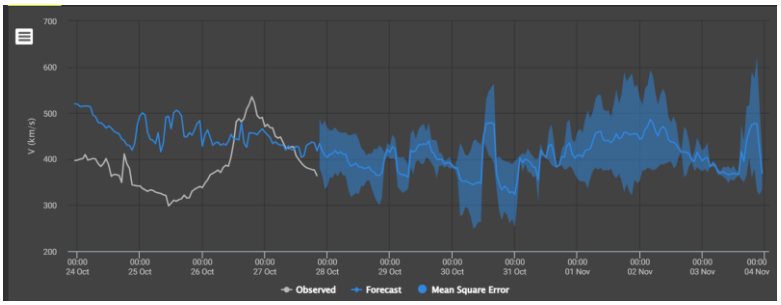
**Figure 3: Met Office Enlil model (top) and persistence model (SWPM. Bottom).**




## Radio Blackouts - X-Ray Flares:

There are currently 4 numbered regions on the visible disc, and one new unnumbered region, all of which are small and magnetically simple. One previously unnumbered region has faded, and AR3468 is now barely visible. Most regions are showing signs of gradual decay and are weak.

There are a couple of bright areas visible on STEREO-EUVI imagery, and so indicating associated energy flux, suggesting the potential for new regions to emerge. One of these areas appears to be associated with the area of plage that contains AR3473 in the northeast, plus new or returning regions may arrive onto the visible disc. This means there is a slight chance of isolated M-flares throughout.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 10 | 10 | 10 | 10 |
| Very Active | R3 to R5 X Class | No | 1 | 1 | 1 | 1 |

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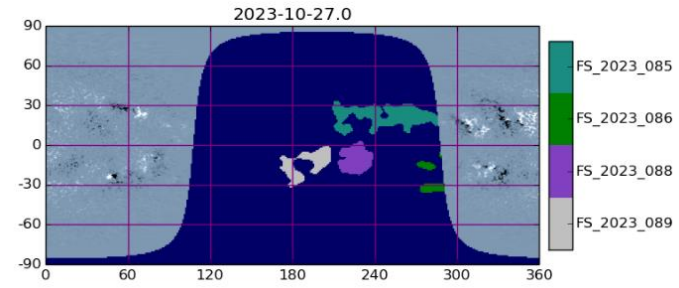
**Figure 4: Potential far side regions.**




| Designation | Centroid Longitude (degree) | Centroid Latitude (degree) | Strength | ETA at East Limb (yyyy-mm-dd.d) | Days from East Limb |
|---|---|---|---|---|---|
| FS-2023-086 | 279.7 | -25.7 | 715 | 2023-10-27.8 | 0.8 |
| FS-2023-085 | 246.8 | 22.1 | 4198 | 2023-10-30.0 | 3.0 |
| FS-2023-088 | 225.5 | -12.0 | 2397 | 2023-10-31.7 | 4.7 |
| FS-2023-089 | 191.7 | -14.1 | 2330 | 2023-11-03.3 | 7.3 |

## Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels in the absence of significant sunspot regions on the visible disc.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 1 | 1 | 1 | 1 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

## High Energy Electrons Event (≥ 2MeV):

Electron flux observed by GOES16 at GEO is currently at generally moderate levels, due to a slight increase in high energy electrons through the Van Allen Belt following the recent coronal hole enhancement from CH64. There is a slight chance of reaching High at the diurnal peak today (28 Oct). Flux levels are then expected to rapidly decrease to background levels tomorrow or early day 3 with the onset of the HSS and associated geomagnetic activity. Then little change is expected until late day 4 (31st) when flux levels are likely to quickly increase under the influence of the HSS, probably reaching High levels by the end of the period.
The associated 24 hour fluence is forecast to remain below the Active threshold (1e8 integrated pfu), but with an increasing trend today and again during day 4 (31st). This is supported by REFM, though persistence provides a poor guide due to influence of CMEs on the previous rotation.

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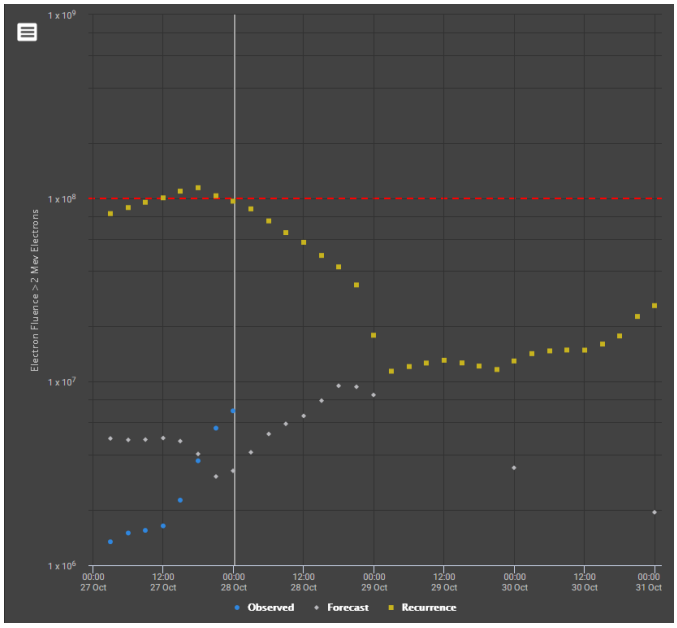
| GEO Electron Environment<br>Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 10 | 10 | 20 | 50 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

**Figure 5: Met Office REFM model.**

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